

Ont. Agricultural mechanics course. Senior division 1966



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# AGRICULTURAL MECHANICS COURSE

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## THE AGRICULTURAL MECHANICS COURSE

The following technical courses are proposed for study in grades 11 and 12 by students of the Four-Year Science, Technology and Trades Program who specialize in Agricultural Mechanics.

Students who elect the above course as their "Major" study will first have taken the exploratory technical subjects in Grades 9 and 10 of the Four-Year Science, Technology and Trades Program, and must have studied the Agricultural course (R.P. - 21) in either or both of these years.

The aim of the courses is to prepare students residing in areas of Ontario where the economy is based on agriculture and related industry to enter gainful employment in these fields, or to proceed to further education in the diploma courses of the Agricultural Schools.

It is proposed that *three* or *four* of the following technical courses should be studied during Grades 11 and 12, depending on local conditions of employment, technical facilities within the school, and time-tabling.



# DRAFTING / FOR STUDENTS MAJORING IN AGRICULTURAL MECHANICS

*Note: This course is intended to provide practice in the interpretation of drawings and in the obtaining of information from them. The course is NOT intended to stress the production of drawings.*

## Mechanical Drafting:

- (a) Review of basic principles of mechanical drafting; use of automotive parts, agricultural implements and tractor parts for illustrative material and projects.
- (b) Fundamentals of sketching; projects as in (a).
- (c) Welding symbols, drawings of fabricated shapes.
- (d) Piping symbols, piping layouts, single line, double line, isometric.
- (e) Blueprint reading with emphasis on:  
Identification of materials  
Methods and order of assembly and dismantlement  
Special devices, linkages  
Lubrication points  
Materials employed in fabrication  
Special views and projections

*Note: Illustrative material should be selected from sources related to the agricultural implement field, and should feature exploded and other pictorial views, charts and assembly drawings.*

## Architectural Drafting:

### 1. Building Construction

The discussion and preparation of sketches and drawings showing details and construction involving:

- (a) Foundations and footings: soil conditions, slab, plain and reinforced footings, foundation waterproofing, calculations.
- (b) Frame wall construction: elements of Western, balloon, and braced framing.
- (c) Masonry wall construction: wall thickness, face and backing units.
- (d) Wood floor construction: joist arrangements, bridging, built-up beams, trimming.
- (e) Windows and doors: types of units available, pre-fabricated units, use of manufacturers' catalogues.
- (f) Stairs: open string construction, tread-riser relationship, handrail relationship.
- (g) Wood roof framing: construction and elements of flat, lean-to, hip, gable, gambrel and mansard types.

### 2. Building Materials and Methods

- (a) Properties of materials: hardness, tenacity, ductility, brittleness, etc.
- (b) A study of the special properties of the following building materials: wood, brick, Portland cement, concrete, gypsum products, masonry, tile, paint, insulation, metals.

*Note: Discussions should include concern for strength, economy, special precautions, types of tests that can be applied, mix proportions, defects, grades and varieties of the above materials.*

- (c) Building by-laws and practices, authorities and legal requirements.
- (d) Blueprint reading; study of building construction drawings with emphasis on:  
House wiring circuits, service entry, distribution  
Plumbing arrangements, hot and cold water supply pipe and pipe fittings, gas piping  
Drainage, soil pipe, wastes, vents, septic tanks  
Heating installations, different types, controls, ductwork, insulation.

### 3. Electricity

- (a) Wiring diagrams for appliances, farm equipment and pumps.
- (b) Control circuits for heating and refrigeration equipment, farm water supply.
- (c) Motor and generator connection diagrams.
- (d) Diagrams and specifications for the installation of equipment.
- (e) Transformer connections for lighting and power circuits.
- (f) Blueprint reading: study and interpretation of circuit diagrams, wiring diagrams, equipment schematics.

### 4. Optional

- (a) Strength of materials: stress, strain, and elasticity, ultimate stress, factor of safety, shear, strength of joints, beams, and bending. Physical properties of materials, use of handbooks.
- (b) Estimating, material costs, catalogues, labour costs, overheads.
- (c) Map reading, survey maps, physical contours, interpretation.

# BUILDING CONSTRUCTION / FOR STUDENTS MAJORING IN AGRICULTURAL MECHANICS

## 1. Safety Regulations and Procedures

- (a) General maintenance and proper operation of portable tools and machines.
- (b) Scaffolds: safe erection procedure.
- (c) Safety codes and rules as recommended by the Industrial Accident Prevention Association; safety regulations for various trades.

## 2. Interpreting Plans and Specifications

- (a) Building terminology: footing to chimney cap.
- (b) Construction drawings: reading, estimating materials and quantities.
- (c) Materials: builders' hardware, lumber, plywood, bricks, blocks, costs, ordering.
- (d) Local Building Codes: by-laws, restrictions.

## 3. Construction Fundamentals and Procedure

- (a) Layout of site: use of surveying instruments, lot lines, and batter boards, sizes and squaring.
- (b) Excavation: soil conditions, grade lines.
- (c) Concrete forms: footing, keyways, walls, piers, columns, slabs, reinforcing.
- (d) Concrete: proportions and aggregates, foundation blocks and anchors, testing and analysis, pouring methods, curing, frost protection.
- (e) Brick and block work: bonds, tools, laying.
- (f) Waterproofing: types, application.
- (g) Drainage: soil conditions, eavestroughing, weeping tiles, sump pumps, culverts.

### (h) Framing:

Floor construction: sill plates, girders, joists, hangers, headers, bridging, stair openings (wells), sub-flooring.

Wall construction: platform, balloon, plank, beam, pole, block and brick, bracing, plates, studs, headers, cripples, girths, trimmers.

Prefabrication: exterior wall coverings, finish and trim; sheatings and composition hardboards; vapour barriers; cornice and roof overhang; types of sidings; types of doors and windows; hanging doors.

Roof construction: terminology, framing square, gable, hip, valley, sheating, shingles, flashings, chimney saddles.

- (j) Stairs: terminology, basement, porch, handrails.

- (k) Simple Cabinet Construction: frames, doors, drawers.

## 4. Allied Trades

- (a) Sanitation: plumbing and drainage systems.
- (b) Electrical: fixtures and convenience outlets.
- (c) Painting and decorating: types and methods.
- (d) Exterior completion: walks, driveways, sodding, grading.
- (e) Heating: electric, hot water, forced air.

### Plumbing:

- 1. Types of pipe, sizes, applications (threaded, copper, cast iron, plastic)

- (a) Measuring, cutting, threading, reaming, soldering, caulking.
- (b) Fittings, valves, applications.

### 2. Water Supply

- (a) Private water supply systems.
- (b) Basic pump principles.
- (c) Centrifugal and reciprocating pumps.
- (d) Shallow and deep well pumps.
- (e) Pressure systems.
- (f) Hard and soft water.
- (g) Theory of water softeners.

### 3. Drainage

- (a) Private disposal systems, building codes, restrictions, jurisdiction.
- (b) Drawing and use of drainage plans.
- (c) Methods of grading drains.
- (d) Properties and applications of vitreous tile, asbestos-cement pipe, fibre pipe.
- (e) Weeping tile installation.
- (f) Simple floor drains and traps.
- (g) Rainwater leaders.

### 4. Maintenance

- (a) Causes and prevention of choked wastes and fixtures.
- (b) Locating stoppages.
- (c) Clearing of stoppages.



# MOTOR MECHANICS/ FOR STUDENTS MAJORING IN AGRICULTURAL MECHANICS

1. The Internal Combustion Gasoline Engine (Single Cylinder)
  - (a) The single cylinder, four-stroke cycle engine:  
component parts and functions,  
the four-stroke cycle principle, the operating systems  
lubrication: need, types  
cooling: purpose, methods  
fuel: purpose, fuel and air flow  
ignition: parts of flywheel, magneto, ignition system.  
periodic maintenance and repair service procedures.
  - (b) The single cylinder two-stroke cycle engine:  
advantages and disadvantages,  
component parts and functions, operation.  
periodic maintenance and repair service procedures.
  - (c) Small engines applications and variations:  
special features to suit such application as  
mowers, chain saws, outboard motors with industrial applications.
2. Multiple Cylinder Gasoline Engines (Four-Stroke Cycle)
  - (a) Component parts: purpose, construction and functions.
  - (b) Multiple cylinder characteristics:  
four-stroke cycle principle  
power overlap  
crankshaft construction and angles  
relative piston positions.
  - (c) Valve and valve seat reconditioning:  
inspection of seats, guides, stem, face;  
resurfacing the valve face and seat.
  - (d) Valve and valve system diagnosis:  
engine temperature  
valve adjustments  
causes of valve failure and characteristics of failure  
the compression test and evaluation of test results.
  - (e) Cylinders:  
cylinder surface condition and causes of various conditions;  
cylinder measurements; taper; out of round  
cylinder reconditioning; ridge; deglazing; honing.
- (f) Pistons, rings, pins and connecting rods:  
construction, materials, types  
cleaning and reconditioning  
piston pin fitting  
connecting and alignment  
fitting piston rings.
- (g) Crankshaft and bearings:  
inspection and measurements  
installation and bearings  
bearing clearance  
torque specifications.
- (h) Engine lubricating oils:  
characteristics of friction  
S.A.E. ratings  
A.P.I. ratings.
- (i) Engine lubrication systems:  
function, types and lubrication circuits  
oil pump and relief valves  
oil filters  
periodic maintenance and service requirements.
- (j) Engine cooling systems:  
purpose, operation of water pump  
pressure caps, thermostats, shutters  
inspection, care and maintenance.
3. Diesel Engines
  - (a) General characteristics:  
similarities to gasoline engine  
comparison of fuel characteristics  
compression ratio of diesel engines  
general operating principle.
  - (b) Fuel injectors:  
construction, operation  
repair service requirements.
  - (c) Fuel injector pumps:  
general construction and operation  
maintenance and repair service requirements.
4. Governors  
centrifugal and velocity types  
construction; operation of typical units  
maintenance and repair service requirements.

## 5. Drive lines

- (a) Power flow through units involved, and relationship one to another.
- (b) The standard clutch: construction, operation adjustments, maintenance and repair service.
- (c) Hydraulic drive units:  
general principles of construction and operation of fluid couplings and torque converters.
- (d) Torque multipliers:  
operation of simple planetary gear sets  
operation of bands and clutches.
- (e) The transmission gear box:  
component parts  
power flow through first, second, third  
shifting mechanisms  
synchromesh units: purpose and operation.
- (f) Gear ratio:  
various ratio obtained through use of simple and multiple gear sets  
power take of power flow; regular or live types.
- (g) Transmission:  
transmission lubrication and lubricants  
transmission care and repair service requirements.
- (h) Differential and rear axle assembly:  
power flow  
gear ratio  
operation of differential gear sets  
"differential lock" mechanism  
lubrication, care and maintenance.

*Break off here if course is divided between Grades 11 and 12.*

## 6. Engine and Drive Line Mechanical Defects

- (a) Diagnosis of noises, missfires, loss of power, overheating, excessive oil consumption and other defects.
- (b) Diagnosis of drive line malfunctions.

## 7. Electrical Systems

- (a) Provide a general background on basic electrical fundamentals, electrical circuits, and electrical test instruments.
- (b) Basic fundamentals of magnetism: permanent, electro, as well as details of magnetic induction.

## (c) The ignition system:

component parts  
construction and operation of coil and condenser distributor maintenance service including adjustments and testing  
automatic and vacuum advance mechanisms  
spark plug inspection, heat range and maintenance service  
ignition timing adjustments.

## (d) Magneto ignition systems:

detailed construction, operation and maintenance service of a flywheel magneto  
construction, operation and maintenance service of a rotating magnet type magneto.

## (e) The cranking system:

the cranking circuit and component parts  
battery construction, operation, testing, and charging  
cranking motor construction and operating principles and types of drive assembly  
cranking motor switches and solenoids:  
construction and operation  
cranking system diagnosis, maintenance and repair service.

## (f) The charging system:

charging system circuit and relationship of component parts  
the DC generator, construction and operation  
the three brush generator, construction and operation  
generator repair service and tests  
general operation of the charging system regulators: cutouts, current regulators, and voltage regulators  
charging system: diagnosis and maintenance service requirements.

## (g) Lighting circuits and component parts: (optional)

circuit diagrams, lamps, switches, fuses, circuit problems and maintenance service.

## 8. The Fuel System

- (a) The fuel system and its component parts.
- (b) The construction and operation of a mechanical fuel pump.
- (c) The principles of carburetion related to the single barrel and the updraft carburetor adjustments.



- (d) The fuel system periodic cleaning, service and adjustments.

## 9. Hydraulics

- (a) Basic principles and applications
  - construction and operation of piston, gear and rotary hydraulic pumps
  - operating cylinders: single and double action types
  - operating controls, valve units, high pressure hoses and fittings
  - hydraulic system maintenance and repair service.

- (b) Power steering:
  - operation and construction of prominent types
  - maintenance and repair service requirements.

## 10. Brakes and Steering

- (a) Construction and adjustments of popular types of steering gears.
- (b) Brakes:
  - construction and operation of mechanical and hydraulic brake systems.

# GAS AND ARC WELDING / FOR STUDENTS MAJORING IN AGRICULTURAL MECHANICS

## 1. Oxy-acetylene Welding Theory

- (a) Safety precautions: operator, helper, bystander, spark and fire control; first aid.
- (b) The care and operation of equipment, setting of gas pressures, welding and cutting theory.
- (c) Control of expansion and contraction. Techniques for minimizing distortion. Forehand and backhand welding technique and theory.
- (d) The welding of mild steel, carbon steels, cast iron; associated problems. Types of filler rods and their application.
- (e) The technique and theory of braze-welding and brazing.
- (f) Fluxes: their compositions and applications.
- (g) Pre-heating, post-heating and stress-relieving.
- (h) Welding in the flat, vertical, and overhead positions. Angles of torch and rod. Selecting filler rods.
- (i) Preparation of plates for the single vee butt joint. Factors affecting root opening and root face.
- (j) Welding of non-ferrous metals. Characteristics of aluminum, copper and brass. Selection of filler rods.

## 2. Oxy-acetylene Welding Practice

- (a) Review and practice basic flat position welds and joints.
- (b) Running weld beads on butt, lap and tee joints in the vertical position.
- (c) Running weld beads on butt, lap and tee joints in the horizontal position.
- (d) Braze-welding of steel and cast iron using coated and uncoated rods.
- (e) Oxy-acetylene cutting: straight line and bevel.
- (f) Fusion welding of cast iron.
- (g) Hard surfacing and build-up as applied to flat and cylindrical surfaces on ferrous and non-ferrous metals.
- (h) Brazing, braze-welding and fusion welding of non-ferrous metals such as aluminum, copper and brass.

## 3. Electric Arc Welding Theory

- (a) Safety precautions: operator, helper, bystander, control of high voltage, spark and fire hazards; first aid for burns to skin and eyes.

- (b) Review: power supplies, machines, and equipment. The advantages and disadvantages of AC transformers, DC rectifiers, and motor generator welding equipment; the duty cycles of machines; polarity.
- (c) Types of electrodes: classification, coding, and application. Voltage and amperage settings.
- (d) Theory of arc welding: factors affecting arc formation. The study of penetration, speed of travel, slag control.
- (e) Types of arc welding: shielded arc, unshielded arc, carbon arc. Arc lengths.
- (f) Preparation of plates for the single vee butt joint. Factors affecting root opening and root face.
- (g) Distortion and welding problems: low, medium and high carbon steel, cast iron and non-ferrous metals.
- (h) Use of jigs, fixtures and backing plates to position work and control distortion.
- (i) Destructive and non-destructive testing of welds.

## 4. Electric Arc Welding Practice

- (a) Set-up and operation of AC and DC welding machines. Power supplies. Selection and setting of voltage and amperage requirements for electrodes and material thicknesses.
- (b) Joining of weld beads, pad welding by running beads in opposite directions.
- (c) Penetration passes and multi-passes. Weaving techniques.
- (d) Electrode angles for surface and penetration welding and racking.
- (e) Testing of welds for grain growth, ductility, elasticity, and strength.
- (f) Study of fusion, undercut, overlap, reinforcement, and adhesion.
- (g) Position of materials and procedures in making lap, butt, and fillet welds.
- (h) Welding in the flat, vertical, and overhead positions.
- (i) Pipe welding: edge preparation and welding techniques.
- (j) Build-up and hard surfacing of worn surfaces. Use of special electrodes.
- (k) Non-ferrous metal welding. Arc length, reverse polarity, backing plate, power supply.

# ELECTRICITY / FOR STUDENTS MAJORING IN AGRICULTURAL MECHANICS

## 1. Electrical Safety

- (a) Safety in the house, on the farm.
- (b) Hazardous situations.
- (c) Artificial respiration and first aid.

## 2. H.E.P.C. Rules and Regulations

A study of the Ontario Electrical Code of the Hydro-Electric Power Commission of Ontario. Its application to electrical installation generally, and to farm installations in particular.

## 3. Circuits

- (a) A study of planned adequate wiring.
- (b) Safety, suitability, capacity, cost.
- (c) The installation of electrical services:
  - service size
  - service planning
  - service location
  - typical service entrances
  - underground services
  - service entrance panels
  - service metering
  - service grounding.
- (d) More advanced study of circuits for domestic light, heat and power:
  - branch circuits
  - general-purpose circuits
  - 3-way and 4-way circuits
  - outside wiring
  - underground lines
  - motor installation and control circuits, uses of wiring materials and conductors
  - use of rigid conduit and E.M.T.
  - use of conduit fittings.

## 4. Circuit Protection

- (a) Study of capacity and load.
- (b) Fuses: all types.
- (c) Other overload protection devices.

## 5. Meters and Test Equipment

Study of meters and test equipment as would be used for basic measuring in installation, testing, maintenance, and repair.

## 6. Maintenance

- (a) The testing and repair of appliances for light, heat and power.
- (b) Test and repair of low voltage devices.
- (c) Checking for overloads, shorts, opens, grounds.
- (d) Repair of common appliances, ranges, water heaters.
- (e) Test and minor repairs on rotating equipment and controls.
- (f) Emphasis on repair and maintenance of hand power tools, cables, and switches.
- (g) Care and maintenance of storage batteries, care and maintenance of automobile starter, generator, and relays.
- (h) Maintenance and repair of heating and cooling equipment.
- (i) Electric heating installation, repair and maintenance.

## 7. Transformers

- (a) Principle: turns, ratio, voltage, and current.
- (b) Construction.
- (c) Types.
- (d) Application.
- (e) Simple installation and maintenance.

## 8. Lighting

- (a) An introductory study of lighting.
- (b) Lighting fixtures.
- (c) Adequate lighting requirements, minimum requirements for various applications.
- (d) Light measurement and practical units of light:
  - radiation spectrum
  - candle power
  - the lumen
  - the inverse square law.
- (e) Types of lighting:
  - incandescent
  - fluorescent
  - cold cathode
  - mercury vapour.
- (f) Types of fixtures and their application.



- (g) Lighting controls related to above equipment:  
resistance and silicon controlled rectifier dimming  
equipment, photocells and timers  
G.E. remote controlled wiring.
- (h) A study of lighting plans for homes and farms.

#### 9. Electrical Measurement

- (a) A stress to be placed on the correct use, care and application of instruments.
- (b) The D'Arsonval Galvanometer:  
parts and function.
- (c) Meters, types and application:  
voltmeter  
ammeter  
ohmmeter  
wattmeter  
kilowatt hour.
- (d) Measurement of power.

#### 10. Direct Current Motors (and Generators)

- (a) The motor principle.
- (b) DC motors, types, connection, parts and their functions.
- (c) Characteristics of shunt, series, and compound motors.
- (d) Stress on DC farm and automotive equipment.
- (e) DC motor maintenance:  
bearings  
commutator  
brush gear.

#### 11. Alternating Current Motors

- (a) The motor principles
- (b) AC motors: connections, parts and their functions.
- (c) Types:  
synchronous  
shaded pole  
universal  
split phase, induction, capacitor  
repulsion induction.
- (d) Motor selection and application.
- (e) AC motor maintenance.

#### 12. Relays

- (a) Principles, construction, type, application.
- (b) Automotive types.
- (c) G.E. lighting relays.

#### 13. The Small Generating Plant

- (a) The Generator Principle.
- (b) Gasoline-diesel powered farm generators.
- (c) Types of standby systems.
- (d) Manual and automatic transfer switches.
- (e) Standby plant installation and maintenance.









